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## Claims

I claim:

- 1 1. An emitter controlled thyristor device having a cathode terminal and an  
 2 anode terminal, comprising:  
 3 a thyristor device having a thyristor emitter, a thyristor collector, and  
 4 a thyristor gate, said thyristor comprising alternating P-type and N-type  
 5 semiconductor regions;  
 6 a first metal oxide semiconductor transistor (MOS) connected in  
 7 series with said thyristor between said cathode terminal said thyristor  
 8 emitter, said first MOS transistor integrated in at least one of the  
 9 semiconductor regions of said thyristor; and  
 10 a second MOS transistor integrated in at least one of said  
 11 semiconductor regions connected between said cathode terminal and said  
 12 thyristor gate, a gate terminal of said second MOS transistor connected to  
 13 said cathode terminal,  
 14 wherein a first voltage applied to a gate terminal of said first MOS  
 15 transistor causes a forward current to flow between said cathode terminal and  
 16 said anode terminal turning said emitter controlled thyristor device to an on  
 17 state, and a zero to second voltage [turns] applied to said gate of said first  
 18 MOS transistor turns said emitter controlled thyristor device to an off state.

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from F  
(12) 1  
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1 2. [An emitter controlled thyristor device] as recited in claim 1 further  
 2 comprises a floating ohmic contact (FOC) for shorting said emitter and a  
 3 source terminal of said first MOS transistor.

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1 3. [An emitter controlled thyristor device] as recited in claim 1 further  
 2 comprises a metal strap for shorting said thyristor emitter and a source  
 3 terminal of said first MOS transistor.

Fig. 10 1

1 4. [An emitter controlled thyristor device] as recited in claim 1, further

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comprising:

a third MOS transistor having a source and a drain connected between <sup>said</sup> thyristor emitter and a thyristor lower base region, and a gate connected to said cathode terminal.

5. [An emitter controlled thyristor device] as recited in claim 1 wherein said first MOS transistor comprises a PMOS transistor, and said second MOS transistor comprises a PMOS transistor.

6. [An emitter controlled thyristor device] as recited in claim 4 wherein said first MOS transistor comprises a PMOS transistor, said second MOS transistor comprises a PMOS transistor, and said third MOS transistor comprises an NMOS transistor.

7. [An emitter controlled thyristor device] as recited in claim 4 wherein said first MOS transistor comprises a NMOS transistor, said second MOS transistor comprises a PMOS transistor, and said third MOS transistor comprises an NMOS transistor.

8. [An emitter controlled thyristor device] as recited in claim 4 further comprising a metal strap for shorting said thyristor emitter with one of a drain and source terminal of said first MOS transistor.

9. [An emitter controlled thyristor device] as recited in claim 1, further comprising a diode connected between said gate of said first MOS <sup>transistor</sup> and said thyristor emitter.

10. An emitter turn-off thyristor (ETO) device for carrying current between a cathode terminal and an anode terminal, comprising:  
a thyristor having a thyristor emitter, a thyristor collector connected to said anode terminal, and a thyristor gate; and

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fig. 4B  
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fig. 2B  
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figs. 9A, 9B

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5 a packaged metal oxide semiconductor (MOS) transistor connected  
6 between said thyristor emitter and said cathode terminal, wherein said  
7 thyristor is turned on to conduct current between said cathode and said anode  
8 terminal by applying a first voltage to a gate of said MOS transistor and  
9 turned off by applying a second voltage to said gate of said MOS transistor.

1 11. An emitter turn-off thyristor (ETO) device as recited in claim 10 further  
2 comprising:

3 a diode connected between said thyristor gate and said cathode  
4 terminal, wherein a threshold voltage of the diode is higher than a voltage  
5 drop across the thyristor gate to cathode plus a voltage drop across said MOS  
6 transistor in an on-state.

1 12. An emitter turn-off thyristor (ETO) device as recited in claim 11, further  
2 comprising:

3 a charge storage device connected in parallel with said diode, said  
4 charge storage device providing a turn-on current for said thyristor gate.

1 13. An emitter turn-off thyristor (ETO) device as recited in claim 12  
2 wherein said diode comprises at least one Zener diode.

1 14. An emitter turn-off thyristor (ETO) device for carrying current between  
2 a cathode terminal and an anode terminal, comprising:

3 a thyristor having a thyristor emitter, a thyristor collector connected  
4 to said anode terminal, and a thyristor gate;

5 a first metal oxide semiconductor (MOS) transistor connected  
6 between said thyristor emitter and said cathode terminal;

7 a charge storage device connected between said thyristor gate and  
8 said cathode terminal; and

9 a second MOS transistor connected in parallel with said charge  
10 storage device, wherein said thyristor is turned on to conduct current

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figs. 13A, 13B

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11 between said cathode and said anode terminal by applying a first voltage to a  
12 gate of said first MOS transistor and turned of by applying a second voltage  
13 to said gate of said first MOS transistor.

1 15. An emitter turn-off thyristor (ETO) device as recited in claim 14  
2 wherein said second MOS transistor is a PMOS transistor having its gate  
3 terminal and drain terminal connected together to said cathode terminal.

1 16. An emitter turn-off thyristor (ETO) device as recited in claim 14  
2 wherein said second MOS transistor is a NMOS transistor having its gate  
3 terminal and source terminal connected together.

1 17. An emitter turn-off thyristor (ETO) device package comprising:  
2 a first die comprising a gate-turn off thyristor (GTO), said first die  
3 having an anode terminal, a thyristor gate, and at least one emitter finger;  
4 and  
5 at least one second die comprising a metal oxide semiconductor  
6 (MOS) transistor connected in series with said first die, a first terminal of  
7 said MOS transistor contacting at least one said emitter finger, and a second  
8 terminal of said MOS transistor acting as a cathode terminal,  
9 wherein a first voltage to a gate of said MOS transistor turns said  
10 thyristor on passing current between said cathode terminal and said anode  
11 terminal, and a second voltage to a gate of said MOS transistor turns said  
12 thyristor off.

1 18. An emitter turn-off thyristor (ETO) device package as recited in claim  
2 17, further comprising:  
3 a plurality of said emitter fingers on a surface of said first die;  
4 a plurality of said second die, each comprising a MOS transistor  
5 connected in series with said first die on one of said plurality of emitter  
6 fingers; and

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figs. 15A, 15B

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7 a metal strip sandwiched between each of said plurality of emitter  
8 fingers and each of said plurality of second die.

1 19. An gate turn-off (GTO) thyristor device package comprising:  
2 a first metal plate;  
3 a second metal plate;  
4 a third metal plate electrically insulated from said second metal layer;  
5 a thyristor sandwiched between said first metal plate and said second  
6 metal plate, a collector of said thyristor contacting said first metal plate  
7 acting as an anode for [said ETO device package];  
8 a first metal oxide semiconductor (MOS) transistor positioned on said  
9 second metal plate adjacent said thyristor, said first MOS transistor having a  
10 first terminal connected to an emitter of said thyristor and [a second terminal  
11 connected to said third metal plate acting as a cathode for [said ETO device  
12 package]; and  
13 a second MOS transistor positioned on said second metal plate  
14 adjacent said thyristor, said second MOS transistor having a first terminal  
15 connected to a gate of said thyristor, said second MOS transistor further  
16 having [a second terminal and a gate terminal connected to said third metal  
17 plate],  
18 wherein a first voltage applied to a gate terminal of said first MOS  
19 transistor turns said thyristor to an on state causing a current to flow between  
20 said cathode and said anode, and a zero to second voltage applied to said  
21 gate of said first MOS transistor turns said emitter controlled thyristor device  
22 to an off state.

1 20. An gate turn-off (GTO) thyristor device package as recited in claim 19,  
2 further comprising a clamp means for holding said first, second and third  
3 metal layers together.

1 21. An gate turn-off (GTO) thyristor device package as recited in claim 19

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figs. 17A, 17B

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2 wherein said first, second, and third metal plates comprise copper plates.

1 22. An gate turn-off (GTO) thyristor device package as recited in claim 19  
2 wherein said first MOS transistor and said second MOS transistor are  
3 complementary.

1 23. An gate turn-off thyristor (GTO) device package comprising:  
2 a gate turn-off (GTO) thyristor comprising a thyristor gate, a  
3 thyristor emitter, and a thyristor collector forming an anode terminal;  
4 a plurality of MOS transistors connected in parallel arranged in a  
5 circular fashion around said GTO thyristor, a first terminal of said MOS  
6 transistors connected to said thyristor emitter and [a second terminal of said  
7 MOS transistors connected to a cathode terminal of said GTO device  
8 package]; and  
9 a plurality of MOS switching devices connected in parallel arranged  
10 in a circular fashion around said GTO thyristor, a first terminal of said MOS  
11 switching devices connected to said thyristor gate and [a second terminal of  
12 said MOS switching devices connected to said cathode terminal of said GTO  
13 device package].  
14 wherein a first voltage applied to a gate terminal of said MOS  
15 transistors turns said GTO thyristor to an on state causing a current to flow  
16 between said cathode terminal and said anode terminal, and a zero to second  
17 voltage applied to said gate of said MOS transistors turns said GTO thyristor  
18 to an off state.

1 24. An gate turn-off thyristor (GTO) device package as recited in claim 23  
2 further comprising:  
3 a first metal plate forming said cathode terminal;  
4 a second metal plate separated from said first metal plate by an  
5 insulation layer, wherein said GTO thyristor and said MOS transistors and  
6 said MOS switching devices are positioned on said second metal plate, said

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B6fig. 2, 17A-17C  
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7 first and second metal plates acting a heat sink.

1 25. An gate turn-off thyristor (GTO) device package as recited in claim 23  
2 further comprising a third metal plate on top of said GTO thyristor forming  
3 said anode terminal.

1 26. An gate turn-off thyristor (GTO) device package as recited in claim 23  
2 wherein said MOS switching devices comprise a MOSFET transistor having  
3 a gate connected to said cathode terminal.

1 27. An gate turn-off thyristor (GTO) device package as recited in claim 23  
2 wherein said MOS switching devices comprise a diode.

1 28. An gate turn-off thyristor (GTO) device package as recited in claim 23  
2 wherein said MOS switching devices comprise a diode connected in parallel  
3 with a capacitor.

1 29. An gate turn-off thyristor (GTO) device package as recited in claim 23  
2 wherein said MOS switching devices comprise a Zener diode connected in  
3 parallel with a capacitor.

1 30. An gate turn-off thyristor (GTO) device package as recited in claim 23  
2 wherein said MOS switching devices comprise a transistor connected in  
3 parallel with a capacitor.

1 31. An gate turn-off thyristor (GTO) device package as recited in claim 26  
2 further comprising;

3 [a first feedback path connecting said gate terminal of said MOS  
4 transistors to said thyristor emitter]; and  
5 a second feedback path connecting said gate terminal of said MOS  
6 transistors to said thyristor gate terminal through a diode.

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fig. 17B

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fig. 19

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fig. 18

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32. A gate turn-off thyristor (GTO) device package as recited in claim 23 further wherein [said MOS switching device] comprises a MOS transistor comprising;

a feedback path connecting said gate terminal of said MOS transistors to said thyristor emitter;

a capacitor connected in parallel to [said second feedback path] connecting said gate terminal of said MOS transistors to said thyristor gate terminal through a diode.

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